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Appendix to accompany the thesis

RADIOMETRIC AGE-DETERMINATION OF BASALTS, DOLERITES AND RELATED
SYENITE IN SKÅNE, SOUTHERN SWEDEN

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DESCRIPTION OF THE SAMPLED LOCALITIES

The regional position of the localities is related to the Greenwich meridian and the equator. It is also referred to the Swedish coordinate system "Rikets nät". The topographical map (scale 1:50 000), where the localities can be found, is given. The appendix belongs to a thesis which contains a map (Fig. 3) of the sampled localities.

Aleholm

N56°4' E13°55,5

6216,60 1382,55

3D Kristianstad SO

The syenite at this locality is fairly light and coarse-grained. The uncovered part of the syenite is only some few square meters in size. A strongly schistosed gneiss granite is thought to be the wall-rock. It is not uncovered closer to the syenite than about one kilometer. The deposit possibly is a block. Potassium feldspar, quartz, plagioclase, hornblende and biotite are common components, while zircon, apatite and ore appear less abundantly. Potassium feldspar is the main component. The plagioclase is a labradorite.

One Rb-Sr dating has been realized (73063).

Arild

N56°16' E12°34,5

6243,60 1299,50

3B Höganäs NO

This dyke of diabase porphyrite crosses the gneissic bedrock in the direction N80W. The dip is vertical. At the widest place, where the sampling was carried out, the dyke is 15 m wide. The K-Ar dated sample (72013) is collected one meter from the northern contact.

Plagioclase is the main component together with augite and ore. Chlorite, hornblende, biotite and serpentine appear and also some few grains of quartz, epidote and apatite. Needles of amphibole are seen. The biotite, and partly the pyroxene, is chloritized. The plagioclase consists of laths of labradorite. It is a bit sericitized and saussuritized. Extremely long (one centimeter) scales and laths of plagioclase are found in the finely medium-grained rock, although the general length of the plagioclases is around half a millimeter.

The texture is subophitic - ophitic.

Mohrén (1948) described this diabase porphyrite as a rock with a dark green-grey matrix and large light laths of feldspar. Kullaberg s.l. has been described by Hennig (1898), Behrens (foremost 1953) and Forsell (1962).

Assaretorp

N56°3' E14°1'

6213,10 1388,40

3D Kristianstad SO

A dyke of a coarse, subophitic dolerite is partly uncovered in a small, old quarry, where the surrounding rock can not be seen. As the contacts are not visible the dip and the width of the dyke are not completely known. The uncovered part is about 20 m wide. The direction of the dyke looks to be N25E.

Plagioclase (labradorite - andesine) is the main component of the rock (42 %). It is seldom sericitized and saussuritized and it consists of about five millimeters long, somewhat pigmented laths, sometimes showing antiperthite. In notable quantities appear potassium feldspar (18 %), biotite (15 %), clinopyroxene (12 %, augite) and opaque minerals (8 %). Apatite (3 %), hornblende (1 %) and serpentine are noted and also single grains of sphene, calcite, quartz and myrmekite. The percentages are received from K. A. Kornfält.

Three samples have been Rb-Sr dated: 72200, 73315 and 73317. The sample 72200 has been K-Ar dated (72200 wr, 72200 plagioclase and 72200 biotite). The separated fractions have less than 5 % impurities.

Balsberget

N56°6,5' E14°12'

6221,25 1399,65

3D Kristianstad SO

The K-Ar dated sample (72044) is taken from blocks (1 m³) in the western part of the Balsberget hill. An adjacent dyke of this fine-grained, subophitic dolerite has the direction N45E. The surrounding rock is a grey, fine-grained gneiss.

The rock mainly consists of plagioclase laths (65 %) with a length of one millimeter. It is pigmented, sericitized and somewhat saussuri-

tized. Antiperthite appears. The plagioclase is a labradorite. Pyroxene (21 %, foremost augite, but also ortopyroxene) and ore (8 %) are common components as well as needles of apatite (6 %). Brown and green biotite, hornblende and serpentine are found and also single grains of potassium feldspar. The augite is chloritized along cracks and borders. The hornblende appears as an alteration product of pyroxene. K. A. Kornfält has contributed with the percentages.

The dolerite dyke can be found on the geological map of de Geer (1889) and is briefly mentioned in his map description (p 47).

Bjärahalla

N55°55' E13°50,5

6200,65 1377,45

3D Kristianstad SO

6200,45 1377,20

At the Bjärahalla hill a maximally 300 m wide, very coarse-grained dolerite is crossed by a 0.2 - 1.0 m wide dyke of a fine-grained dolerite. The direction of both of them is N40-60E. Contacts to the surrounding gneiss granite can not be seen. The fine-grained dolerite dips vertically. It shows very fine-grained chid margins. The K-Ar dated sample (72194) is taken from the central part of the dyke. From the coarser dolerite, represented by the sample 72195, one whole rock sample, one plagioclase separation and one biotite separation have been K-Ar dated. The plagioclase and the biotite fraction have a purity of 98 respective 95 %. The biotite fraction has strains of pyroxene and ore. A Rb-Sr dating has been carried out on the whole-rock sample.

The fine-grained dolerite to 43 % consists of 1 - 2 mm long, a bit pigmented laths of plagioclase (labradorite), sometimes with antiperthite. Alteration minerals like serpentine, hornblende and epidote make 25 % of the rock. Biotite forms 15 % and ore minerals 7 %. Pyroxene (6 %, augite), apatite (4 %) and calcite (1 %) are found and also some few grains of garnet and quartz.

The length of the plagioclase laths of the coarse dolerite is five millimeters. 74 % of the rock is plagioclase (labradorite) which is partly sericitized and saussuritized. Smaller contents of olivine (7 %), biotite (6 %), opaque minerals (5 %), clinopyroxene (4 %,

augite), apatite (2 %) and potassium feldspar (1 %) are present. The biotite often appears as a border around the opaque grains. Quartz, chlorite, serpentine and micrographic intergrowths of quartz and plagioclase can be found. The percentages are taken from K. A. Kornfält.

Eichstädt (1887 pp 462 - 470) and Törnebohm & Hennig (1904 pp 37 - 39) have described the coarse dolerite. The locality is found on the geological map of Karlsson (1879).

Bjärlöv

N56°7,5 E14°6'

6223,30 1394,00

3D Kristianstad SO

This locality consists of two dykes out of which the western one has been sampled. It is a five meters wide dyke of medium-grained dolerite with the direction N10E. The texture is subophitic. Contacts to the surrounding gneiss granite have not been observed. The two whole-rock dated samples, 72045 (Rb-Sr) and 72046 (K-Ar and Rb-Sr) are collected from the southern part of the slab.

In the old map description of 1889 (p 50) de Geer called this dolerite an olivine diabase.

Under the microscope the rock shows: plagioclase (48 %), pyroxene (32 %, augite), ore (9 %), serpentine (4.7 %), hornblende (2.2 %), apatite (1.9 %) and single grains of biotite, quartz and microcline. K. A. Kornfält has informed about the percentages. The plagioclase (andesine) appears as two millimeters long, slightly pigmented, sometimes sericitized and saussuritized laths, where antiperthite appears. The size of the augites is about the same. The augite is serpentized and chloritized and is sometimes altered to hornblende. The biotite is a bit altered too.

Björnstorp

N55°39' E13°24,6

6171,60 1349,20

2C Malmö SO

This occurrence of dolerite is detailly described by Hjelmqvist (1934 p 123): In the central part of the dyke the dolerite shows a

diabase texture, while the margins are schistosed, amphibolitic and altered and have a pronounced linear habit. Olivine is absent. The pyroxene is a monocline hypersthene augite.

One sample of this medium-grained dolerite (72058) taken from the mineral collection of the Geological Institute at the University of Lund has been K-Ar and Rb-Sr whole-rock dated.

Under the microscope the rock shows plagioclase (labradorite, 1.5 mm long, pigmented laths), pyroxene (augite), hornblende and ore. Biotite, serpentine and small quantities of quartz, apatite and garnet is found. Sericitization and saussuritization of the plagioclase laths can be seen.

The locality is mentioned in the map description of Holst (1911 pp 12 - 13).

Blentarp (Bellinga)

N55°32,5 E13°36,5

6158,70 1361,05

2D Tomelilla SV

Two samples (72029 and 72031) from the subophitic dolerite dyke of this large quarry in the southeastern part of the Romeleåsen horst, have been whole-rock K-Ar dated. The medium-grained dyke crosses a grey granitic rock in the direction N15E. The locality was present on the geological map of Munthe, then called a bronzite diabase (Munthe et al 1920 p 20).

The rock consists of somewhat sericitized laths of plagioclase (andesine) and apatite. The serpentinization and chloritization is extensive. The biotite is chloritized. Sericitization of the half a millimeter long plagioclase laths can be seen. Exceptionally, the laths are 1.5 mm in length. The plagioclase is pigmented and antiperthite is found.

Bollerup

N55°29,5 E14°4'

6152,75 1389,85

2D Tomelilla SO

This dyke of a medium-grained dolerite appears as a 25 m wide ridge with the direction N35W. The rock shows an ophitic - subophitic

texture. One sample (71193) from the central part of the highly fissured dyke has been K-Ar dated. The plagioclase and the pyroxene have been K-Ar dated separately. Both of them have a purity of 95 % with impurities of pyroxene respective plagioclase. The main component of the dolerite is a somewhat pigmented plagioclase (labradorite - andesine) appearing as laths. Augite, ore, calcite, serpentine, chlorite, glass and olivine are common components, while talc, apatite and biotite appear accessorially. Micrographic intergrowths of plagioclase and quartz can be seen. The surrounding rock belongs to the Ordovician.

The NW-dolerites by Svedmark (1885 pp 689 - 699) were divided into two groups: proterobases and ordinary diabases. Descriptions of the two types can be found in the descriptions of the geological maps of Trolleholm and Simrishamn by Nathorst (1885 p 27) respective Holst (1892 pp 41 - 42). The same division was accepted by de Geer (1887 pp 28 - 29). The difference between the proterobases and the ordinary diabases, according to Svedmark (1885 p 689), is the existence of hornblende beside the augite in the former. Quartz is always present in the proterobases (Svedmark 1885 p 693). In difference from the short, prismatic apatite crystals of the proterobases the apatite in the ordinary diabases consists of long, needle-like crystals (Svedmark 1885 p 694). In the description of the geological map Holst (1892 pp 39 - 42) regarded the Bollrup diabase as an ordinary diabase in difference from the also appearing proterobases, for example the diabase at Simrislund. He characterized the ordinary diabases from the contents of more bright, less broken plagioclase laths and brownred augite. The proterobases on the other hand have two types of augite: beside the general type a light, easily weathered salite appears. Other typical components are hornblende, quartz, myrmekite, biotite and long lists of apatite (Holst 1892 p 41). De Geer (1887 p 29) suggested that the proterobases, which only appear in areas exposed to great denudation, are ordinary diabases just stiffened at a greater depth.

Brantaberg

N56°5,5 E13°53'

6219,70 1380,00

3D Kristianstad SO

The locality Brantaberg consists of three small quarries, where

syenite has been broken. A two meters wide dyke of fine-grained dolerite intersects the syenite in the northern quarry. The dolerite dyke strikes N30W and dips 70SW. The syenite probably is surrounded by a gneiss granite.

The syenite under the microscope shows potassium feldspar (42 %), plagioclase (25 %, labradorite), quartz (16 %), hornblende (11 %) and pyroxene (3 %). Biotite, zircon, ore, garnet and apatite appear accessorially.

K-Ar dating has been realized on the syenite (72042 wr and 72042 hornblende) and on the dolerite (72040 wr). The purity of the hornblende fraction is very high (98 %). The syenite has been dated also with the Rb-Sr method (72042 and 73065).

The dolerite under the microscope looks altered but shows saussuritized plagioclase laths, ore and pyroxene as common components and also some quartz and apatite. The texture seems to be subophitic.

Brostorp

N55°58' E13°48,5

6206,00 1375,00

3D Kristianstad SO

The direction of this, on the highest 50 m wide, dolerite dyke is N50E. One sample of this rock (72198) has been K-Ar dated and one from an intersecting, narrow, fine-grained dyke of dolerite (72197). The direction of the intersecting dyke is N60W and the dip is 80S. It is composed of laths of plagioclase (labradorite), pyroxene (augite) and ore as dominating components. The pyroxene is chloritized and partly altered to hornblende. The plagioclase is sericitized and saussuritized. Antiperthite is noted. Serpentine, biotite, apatite and quartz are the other components.

The coarser dolerite is finely medium-grained and exhibits a subophitic texture. A red, fine-grained gneiss likely forms the country rock. The components of the coarse dolerite are: plagioclase (52 %, laboradorite, 1 - 2 mm long laths, pigmented and partly sericitized), pyroxene (15 %, augite), biotite (11 %), alteration minerals of pyroxene (11 %, hornblende, serpentine), ore minerals (9 %) and apatite (2 %). Muscovite can be found. K. A. Kornfält has contributed with the percentages.

Dalby

N55°39,2 E13°23,2

6172,00 1347,70

2C Malmö SO

In the giant quarry at Dalby the gneiss is intersected by dykes of dolerite, "kullaite", porphyry and diabase porphyrite. The rocks have been detailly described by Hjelmqvist (1930 pp 247 - 268, 1931 pp 251 - 297, 1934 pp 129 - 140, 154 - 165) and Röshoff (1970). Palaeomagnetic dating of the dolerite has been carried out by Claesson (1971, published by Bylund 1973).

Four samples (71149 - 71152) taken across the fourteen meters wide dolerite dyke in the northwestern part of the quarry have been whole-rock dated, using the K-Ar method. The plagioclase fraction of the sample 71150, with the purity 98 %, has been dated separately. The dyke strikes N55W and dips vertically. The rock is medium-grained except from the fine-grained margins. The sample 71152 is taken from the margin.

The subophitic dolerite mainly consists of plagioclase (andesine - labradorite), augite and ore, but also chlorite, quartz, apatite, some biotite and some calcite. The plagioclase laths (1 mm long) are sericitized and saussuritized. Micrographic intergrowths appear. The augite is uralitized and chloritized. The biotite is a bit chloritized.

Single samples of diabase porphyrite (72056), porphyry (72057) and "kullaite" (72060) from the mineral collection of the Geological Institute at the University of Lund have been whole-rock K-Ar dated.

The diabase porphyrite mainly consists of hornblende, serpentine and plagioclase (labradorite, andesine and oligoclase). Ore, biotite, epidote, apatite, quartz, calcite and some potassium feldspar are also present in this fine-grained rock.

The porphyry shows the main components plagioclase (andesine - oligoclase), potassium feldspar, quartz and chlorite. Calcite and garnet are common. In smaller quantities appear ore, apatite and zircon. The rock is fine-grained and gneissic.

The "kullaite" is green in colour and shows red vesicles. According to Hjelmqvist (1931 p 275, 1939 p 8) the vesicles consist of potassium feldspar, epidote, delessite and calcite. The dyke is four meters wide and strikes N60W. It has a subophitic texture and it is fine-grained. The dominating minerals are plagioclase (laths, andesine), chlorite,

potassium feldspar and ore. Epidote, augite, calcite and apatite are present.

Dalleröd

N56°7' E13°42' 6222,85 1368,85 3D Kristianstad SV

The direction of this dyke of weathered, altered, finely medium-grained dolerite is N55W. The dyke intersects the Precambrian bedrock, however, contacts have not been observed. The texture is subophitic. A single sample (71201) has been whole-rock K-Ar dated.

The rock consists of augite, plagioclase (labradorite - andesine), ore, quartz, chlorite, hornblende, serpentine and some biotite. Saussuritization of the plagioclase is noted and also chloritization of the pyroxene.

Djurröd

N56°0' E13°54,5' 6209,80 1381,60 3D Kristianstad SO

The syenite at Djurröd mainly consists of potassium feldspar, hornblende, quartz and plagioclase. Further augite, ore, biotite, epidote, apatite, zircon and glass are noticed.

One sample (72038) has been K-Ar dated, whole-rock and a concentrate of the potassium feldspar. The potassium feldspar has 2 - 5 % impurities foremost of quartz. The syenite is very dark grey and coarsely medium-grained. The country rock seems to be a porphyritic gneiss granite.

Concerning the denomination in the old map description of Karlsson (1879) see the locality Önnestad.

Fruälid

N55°41,5' E13°40' 6175,20 1365,80 2D Tomelilla NV

The 1,5 km long ridge of Fruälid is extended in N70W. The dip is

vertical. The three K-Ar dated samples are collected from the top of the ridge (71160), from the upper, central (71161) and the lower, eastern (71162) part of the 30 m high, steep northern side of the ridge. No contacts to the surrounding sandstone have been observed. All datings are whole-rock datings.

The vesicular diabase is fine-grained. The sample 71161 is the coarsest one of the three samples. The red-brown, ophitic vesicular diabase also is called Öved diabase. It is characterized by vug fillings of calcite, calcedone and chlorite (Veldy 1951). The main components of the rock are plagioclase (labradorite - andesine) and ore. The plagioclase forms laths, in some cases with a zonal extinction. Antiperthite is found. In subordinate quantities biotite, chlorite, augite, quartz, calcite and apatite exist.

The locality is described by Tullberg (1882 p 33), Törnebohm & Hennig (1904 pp 81 - 84) and Veldi (1951). Bylund (1973) realized palaeomagnetic datings.

Göbnehall (Pilahallen)

N55°58,5 E13°40,5

6207,10 1366,80

3D Kristianstad SV

A preliminary report on the K-Ar dating of this basalt neck is already published (Klingspor 1973). The diameter of the circular neck is about 70 m. The basalt is of a vitrophyric texture. The rock is dense and it is crossed by several cracks of calcite. A quarry uncovers the basalt, however, contacts to the surrounding Precambrian bedrock can not be seen. Columnar structure is partly observed.

The seven K-Ar dated samples (71142 - 71146, 72047 and 72051) are taken from the southern and eastern walls. The samples 71142 and 72047, which show a deviating low age of 139 Ma respective 149 Ma, are taken in the southwestern part of the quarry some meters away from the most adjacent one of the other samples. From two samples (71142 and 71145) the plagioclase fraction and the pyroxene fraction were dated separately. The later fraction is very clean (99 % pyroxene), while the plagioclases have 15 % impurities, foremost of pyroxene.

The rock mainly consists of phenocrysts of augite and olivine

(forsterite), plagioclase laths, glass and ore. Calcite, quartz and microcline are found. The olivine is somewhat serpentinized along cracks. Also the augite phenocrysts are a bit serpentinized. Some of the phenocrysts can be seen by eye.

Eichstädt (1882 pp 34 - 40) described this basalt as a feldspar basalt with a vitrocrystalline porphyry structure and dark glass.

Görbjörnarp

N56°20' E14°9'

6246,20 1397,60

3D Kristianstad NO

This syenite is exposed in several quarries in the area around Görbjörnarp. The wall-rock is a gneiss granite. The syenite is medium-grained and more or less dark grey in colour. Five samples have been whole-rock dated, using the Rb-Sr method (73055, 73058, 73059, 73212 and 73214). One K-Ar dating (71171 wr) has been realized. The six dated samples are all collected within an area of 1.0 x 1.5 km.

The quarries are briefly described by Lundegårdh (1971 pp 145 - 146). On the geological map of Blomberg (1892) the rock is called a gneiss.

The syenite to a great part consists of potassium feldspar but also of plagioclase (labradorite), pyroxene (augite), hornblende and quartz. Ore, biotite, apatite and zircon are present. Ore can be seen in the spalte cracks of the pyroxene. The pyroxene is partly uralitised along the borders. Garnet fails in all the Rb-Sr dated samples but 73212, although the K-Ar dated sample shows a fairly high content of garnet. Quartz is a bit more abundant in 73059 than in the other samples. The sample 73058 has the highest content of light components. Zircon is present in all the samples but 73058. The darkest samples are 73055 and 73212.

Hardeberga

N55°42,5' E13°17,5'

6177,75 1342,10

2C Malmö NO

The Hardeberga sandstone in the large quarry at Hardeberga is

transversed by dolerite dykes. The three K-Ar dated whole-rock samples (71132, 71133 and 71135) were collected across the 20 m wide dolerite dyke in the northwestern part of the quarry. The dyke strikes N70W and dips vertically. The fairly coarse-grained, subophitic dolerite dyke has fine-grained, somewhat more altered child margins. The sample 71135 is taken from the northern margin. From the sample 71132 the plagioclase fraction (purity 98 %) and the pyroxene fraction (purity 90 %, impurities foremost of plagioclase) have been dated separately.

The composition of the dolerite is the following: plagioclase (labradorite - andesine), augite, ore, chlorite, calcite, quartz, apatite, biotite and epidote. Sericitization and some saussuritization of the plagioclase laths are present and also single micrographic intergrowths and antiperthite. The augite is chloritized and uralitized. The biotite is chloritized.

Ejder (1971, published by Bylund 1973) has carried out palaeomagnetic dating of the dolerite. Winkler & Weitz (1956 pp 619 - 641) described a dyke at Hardeberga, then called a basalt. The geology of Hardeberga and Romeleåsen s.l. is described by Troedsson (1930 p 5).

Hägghult

N56°23,5 E14°15,5

6253,10 1404,00

4E Tingsryd SV

A gneiss granitic rock, and locally a quartzite, is the surrounding rock of this dolerite dyke. The sampling was carried out across the 30 m wide dyke in the southern part of the northern quarry of Hägghult. The direction of the dyke is N10E. The central part of the dyke, where two of the K-Ar dated samples were collected (71181 and 71183), is medium-grained, while the margins are fine-grained and schistosed. The sample 71180 from the western margin has been dated. These datings are whole-rock datings. Concentrates of the plagioclase and the pyroxene of the sample 71183 have been dated. They have a purity of 95 % with impurities of pyroxene respective plagioclase and ore.

Plagioclase (labradorite) is the most common component of this subophitic dolerite. It appears as pigmented, slightly sericitized

and saussuritized laths with a length of 1.0 - 1.5 mm. Antiperthite sometimes is seen. Pyroxene (hypersthene + augite), ore, biotite, serpentine, chlorite and apatite form the rest of the rock together with single grains of hornblende, microcline and rutile. The pyroxene is chloritized, serpentinized and uralitized.

Lundegårdh described the locality (1971 pp 147 - 148).

Hörröd

N55°46,5 E14°1'

6184,70 1387,50

2D Tomelilla NO

The direction of this dolerite dyke is N. The width of the uncovered part of the dyke is about ten meters. Contacts to the surrounding Precambrian bedrock have not been seen. The dolerite is subophitic and fine-grained. It foremost consists of plagioclase laths, which are sericitized and saussuritized. The plagioclase is a labradorite - andesine. Other constituents are augite, ore, chlorite, quartz and apatite. Biotite, secondary microcline and antiperthite in small quantities are noted. Chloritization of the pyroxene and the biotite is seen and also micrographic intergrowths of plagioclase and quartz.

The two samples 72035 and 72037 have been whole-rock dated with the K-Ar method. Although the direction, the dyke belongs to the NW-dolerite system as regards the age.

The locality is mentioned in the map description of de Geer (1889 pp 22 - 24).

Konga Klint

N55°58,5 E13°11,2

6208,45 1336,25

3C Helsingborg SO

The direction of this subophitic dolerite dyke is N80W. The intersected rock is a shale referred to the Silurian (Nathorst 1885 p 28). The dolerite shows vugs (1 - 5 mm in size) filled with quartz and calcite. The content of quartz is exceptionally high. The main component of this fine-grained dolerite is plagioclase (labradorite),

appearing as partly sericitized laths. Other common minerals are ore, pyroxene (augite), quartz and chlorite. Micrographic intergrowths of quartz and plagioclase are frequent. Single grains of antiperthite, apatite and biotite are noted. The sample 74190 wr has been K-Ar dated.

The locality is described and pictured by Nathorst (1885 pp 26 - 28).

Kullens fyr, Kullaberg

N56°18' E12°27'

6246,60 1292,35

3B Höganäs NO

A half-circular, about five meters wide dyke of medium-grained, comparatively light dolerite has been K-Ar dated (72019). The surrounding rock is a gneiss.

Under the microscope the subophitic texture is seen, although the rock is fairly altered. The rock shows: sericitized and saussuritized plagioclase laths (labradorite), augite, chlorite, ore, quartz, epidote, apatite and some biotite. The augite is partly replaced by chlorite. Micrographic intergrowths of plagioclase and quartz are seen.

The geology of Kullaberg has been described by Lindström (1880a pp 18 - 20, 1880b pp 20 - 21), Hennig (1898), Behrens (foremost 1953), Troedsson (1930 pp 2 - 5), Hennig (1914 pp 1 - 5) and later on by Forsell (1962).

Kvarnbrodda

N55°35,5' E13°31'

6165,20 1355,90

2D Tomelilla SV

The sample 72033 from this very fine-grained dolerite has been K-Ar dated. The texture is subophitic. The uncovered part of the N70W dolerite dyke is about four meters wide. No contacts to the surrounding gneiss have been observed. As dominating mineral appears plagioclase (labradorite), exhibiting laths, sometimes showing antiperthite. Augite and ore are other essential minerals, while chlorite, biotite, apatite and quartz are of subordinate importance.

The saussuritization and sericitization is slight. The augite is somewhat replaced by chlorite.

Kårestad

N55°55' E13°54'

6200,10 1380,45

3D Kristianstad SO

The direction of this dolerite dyke is about N30E. It intersects a fine-grained gneiss granite, however, contacts have not been observed. The dip is unknown and the uncovered part of the dyke is about five meters wide. Rb-Sr and K-Ar dating have been realized on the sample 72196 wr.

The main components of the dolerite are plagioclase (38 %, labradorite - andesine), alteration minerals of pyroxene (35 %, hornblende, serpentine and some chlorite) and clinopyroxene (22 %, augite). The slightly pigmented plagioclase laths (1 mm in length) are somewhat sericitized and saussuritized. In smaller quantities appear opaque minerals (5 %), garnet (1 %), biotite (1 %) and apatite (1 %). Potassium feldspar and antiperthite are noted. The percentages are received from K. A. Kornfält.

The occurrence is found on the old geological map of Karlsson (1879).

Lönnebjär

N56°0'5 E13°42'

6210,55 1368,45

3D Kristianstad SV

The texture of this basalt neck is of a vitrophyric art. A columnar structure is present. The Precambrian bedrock forms the wall-rock. No contacts have been observed. The rock is dense. It macroscopically exhibits millimeter-large phenocrysts of olivine and vesicles of calcite. Somewhat smaller phenocrysts of augite are present. The phenocrysts lie in a matrix of brown glass, ore, apatite and small laths of plagioclase (labradorite - andesine). A couple of 1.5 mm long laths of feldspar are found. The olivine phenocrysts are a bit serpentized, while the augite phenocrysts are just insignificantly altered.

Four whole-rock K-Ar datings have been realized (71199, 74305, 74312 and 74314) and also a K-Ar dating of a concentrate of plagioclase from the sample 74305 (purity 85 %, impurities foremost of pyroxene).

Karlsson mentioned the locality in his map description (1879 pp 11 - 13) and later Eichstädt (1882 pp 20 - 23) and Norin (1933 p 132) described the locality. Beside the above mentioned mineral components Karlsson stated zeolite.

Mölle, Kullaberg

N56°17,5 E12°29,5

6245,10 1294,75

3B Höganäs NO

This only half a meter wide dyke of fine-grained dolerite has the direction N80W. The surrounding rock is a gneiss. One K-Ar dating (72022) has been realized. The rock is composed of subophitically arranged plagioclase laths (labradorite), ore, pyroxene, chlorite, quartz and calcite. The pyroxene is partly replaced by chlorite. The plagioclase shows some sericitization.

Concerning literature about Kullaberg see the locality Kullens fyr.

Odarslöv

N55°44,5 E13°17,5

6186,75 1341,75

2C Malmö NO

In the large quarry at Odarslöv a dolerite dyke, striking N65W and dipping 70E, intersects the Colonius shale. One sample from the 25 m wide, medium-grained dolerite (73011) have been K-Ar dated and four samples from the shale. The shale samples are collected at the distances 10 m (73012), 30 m (73013), 70 m (73015) and 110 m (73017) from the dolerite contact.

Plagioclase laths (labradorite - andesine, somewhat sericitized) and augite form the main part of the dolerite, which consists of ore, chlorite, serpentine, epidote, quartz and some biotite. The texture is subophitic - ophitic.

Oderljunga

N56°11,5 E13°20,5

6232,00 1347,45

3C Helsingborg NO

With the direction N50W this medium-grained, altered, likely subophitic dolerite appears as a 5 - 10 m wide dyke intersecting the Precambrian bedrock. The dolerite macroscopically shows richness in potassium feldspar. Besides, quartz, plagioclase (labradorite, a bit sericitized), pyroxene, ore, chlorite, serpentine and epidote appear. The content of quartz and micrographic intergrowths of quartz and plagioclase is rather high. Whole-rock dating with the K-Ar method has been carried out on one sample (73010).

In the map description of Lindström (1878 p 12) a quartz diabase in Oderljunga is mentioned.

Petersborg

N55°35' E14°7,5

6162,90 1393,55

2D Tomelilla SO

In a slightly curved ridge with the direction N25W a dolerite dyke is partly uncovered. The dyke is 15 m wide. In the map description of 1892 (pp 39 - 42) Holst regarded the dyke, there called the dyke of Flagabro,^{as} an ordinary diabase (see the locality Bollrup).

Three samples (71188 - 71190) have been K-Ar dated. All of them are fine-grained and subophitic. They have the following composition: plagioclase laths, augite, ore, quartz and calcite. In smaller quantities appear biotite and apatite. Micrographic intergrowths are found. The plagioclase (labradorite - andesine) is sericitized and saussuritized. The augite and the biotite are chloritized. The plagioclase of the sample 71188, pure to 98 %, has been K-Ar dated.

Rallate

N56°2' E13°16,5

6213,80 1341,70

3C Helsingborg SO

This basalt neck shows columnar structure with partly zoned pillars, dipping 30S. The neck has pierced the Precambrian bedrock. In a matrix

of glass, ore and very small plagioclase laths, phenocrysts of olivine (0.5 mm) and augite (0.5 mm) appear - thus a vitrophyric texture. A slight serpentization of the phenocrysts is observed. Zeolite appears as vug fillings. Six K-Ar datings of this dense rock have been realized: 71147 wr, 71147 plagioclase (5 %, impurities mainly of pyroxene), 74291 wr, 74298 wr, 74300 wr and 74302 wr.

Eichstädt (1882 p 45) and Nathorst (1885 pp 63 - 67) considered this basalt to be a colourless feldspar basalt with a vitrocrystalline porphyry structure. The locality is mentioned by Hennig (1914 pp 27 - 28).

Rickarum

N55°59' E13°49,3	6208,05 1375,80	3D Kristianstad S0
N55°59' E13°48,7		

Sampling has been realized at two dykes 600 m apart. The sample 72199 is taken from the best preserved southern dyke and the samples 72208, 73330 and 73332 from a more typical dolerite with schistosed margins farther north. Whole-rock datings with the Rb-Sr method have been carried out for these four samples. The samples 72199 wr, 72208 wr, 72208 plagioclase and 72208 hornblende have been K-Ar dated. The two separations are pure to 95 %. The plagioclase shows impurities of pyroxene, biotite and hornblende and the hornblende of pyroxene and plagioclase.

The direction of the ten meters wide, finely medium-grained dyke of the best preserved type is N50E. It dips vertically. The northern dyke is worse uncovered and the strike and dip are unknown. The wall-rock is a gneiss.

The rock consists of partly sericitized, pigmented plagioclase (40 %, labradorite, with antiperthite), pyroxene (foremost augite), alteration minerals like hornblende and serpentine (38 %), biotite (6 %), garnet (5 %), opaque minerals (4 %), potassium feldspar (3 %), quartz (2 %) and apatite (2 %). The proportions are according to K. A. Kornfält. Muscovite is noted.

Romeleklint

N55°37,4 E13°27'

6168,5 1351,5

2D Tomelilla SV

Already Törnebohm & Hennig (1904 p 39) mentioned the doleritic dykes at Romeleklint. Later on Hjelmqvist (1934) described this dolerite (pp 148 - 152). The coarse-grained dolerite mainly is composed of pigmented plagioclase laths (labradorite), pyroxene and ore. Biotite, hornblende, serpentine, apatite, quartz and garnet are found and also antiperthite. The plagioclase laths reach two millimeters, in some cases three millimeters, in length. They are sericitized and saussuritized and the texture is subophitic. The K-Ar method has been used for a whole-rock dating (72059).

Rumperöd

N56°20' E14°8'

6246,80 1396,55

3D Kristianstad NO

A four meters wide dyke of fine-grained, subophitic dolerite crosses a coarser dolerite. The direction of the fine-grained dyke is N10E and the dip is 55E. Plagioclase (labradorite - andesine, pigmented), pyroxene (hypersthene and augite), ore and biotite form the main part of this rock. The plagioclase laths are somewhat sericitized and saussuritized. Antiperthite can be seen. The laths reach a length of two millimeters. Other components are potassium feldspar, apatite, hornblende, quartz and calcite. The pyroxene is somewhat altered to serpentine and hornblende. The biotite is a bit chloritized. Three K-Ar datings on this fine-grained dolerite dyke have been carried out (71166, 71168 and 71170) and one on the intersected rock (72209). The latter also has been Rb-Sr dated.

The coarser dolerite foremost consists of several centimeters long (6 cm according to Lundegårdh 1971 p 146) plagioclase laths. In considerable quantities exist olivine, biotite, ore, pyroxene and apatite. Epidote and antiperthite are found. The plagioclase is a labradorite.

The quarry at Rumperöd is described by Lundegårdh (1971 p 146). The occurrence can be found on the old geological map of Blomberg (1892).

Rönnarp

N55°57' E12°57,5

6205,65 1322,00

3C Helsingborg SV

A 60 - 70 m wide dolerite dyke in N40W intersects a shale at Rönnarp. The shale, because of the content of the graptolithe *Monograptus colonus*, is referred to the Silurian. The rocks are uncovered in a large quarry. Besides there are several drill-holes in the shale in the surroundings. The dolerite is fine-grained to medium-grained and it contains crystals and millimeter wide cracks of calcite. Macroscopically pyrite can be seen. The texture is subophitic.

Five samples of the dolerite (71137 - 71141), taken across the dyke in the southern part of the quarry, have been K-Ar whole-rock dated. All of them have the main components plagioclase (andesine - labradorite), augite and ore and they also contain chlorite, quartz and calcite. Single needles of apatite and some hornblende are present. Some few grains of biotite are found in the sample 71139, moreover the most coarse-grained sample. The plagioclase laths normally are one millimeter in length, in one case (71139) two millimeters. They are sericitized and saussuritized. The augite, the biotite and also the hornblende partly are altered to chlorite. The biotite in some cases is altered to ore. From the sample 71139 the plagioclase and the pyroxene have been K-Ar dated. Both concentrates are very pure (98 % respective 95 %). The pyroxene has impurities of plagioclase.

The dolerite has been palaeomagnetically dated (Klingspor 1971, published by Bylund 1973). Five samples of the shale have been K-Ar dated (whole-rock; 72024, 72027, 73018, 73020 and 73022).

The dolerites at Rönnarp and in the surrounding area are found in the map description of Erdman (1881 pp 69 - 71). Lindström described the quarry (1960 p 329) and the core drills in the surroundings.

Röstånga mölla

N55°59,5 E13°17,5

6209,60 1343,15

3C Helsingborg SO

This dolerite is medium-grained and highly fissured. The dyke is

about 20 m wide. It strikes N30W. The surrounding rock is a shale ascribed to the Silurian, however, contacts have not been observed.

The main minerals of the K-Ar dated sample, 71194, are plagioclase and augite. Some plagioclase laths reach 1.5 mm in length, but normally they are shorter than 1 mm. Sericitization and saussuritization are present. The pigmented plagioclase is a labradorite which partly shows a zonal extinction. Some antiperthite is found. The pyroxene is chloritized and sometimes uralitized and serpentinized. Ore and biotite are essential components. Apatite, chlorite, serpentine, hornblende and potassium feldspar are present. The rock is fairly altered, but it shows an ophitic texture.

Already on the geological map of Nathorst 1885 this dolerite occurred. Hadding (1922 p 24) described this occurrence.

Simrislund

N55°32',5 E15°21',5

6158,05 1408,65

2E Simrishamn SV

On the shoreline, 1.5 km south of the town Simrishamn this 15 - 20 m wide, highly fissured dolerite dyke is found. The wall-rock, a Lower Cambrian sandstone, is not exposed next to the dolerite dyke. The dyke strikes N30W and dips 30E. One whole-rock K-Ar dating has been carried out on this medium-grained rock (71185).

The rock consists of: plagioclase (labradorite - andesine), ore, augite, serpentine, chlorite, quartz, hornblende and single grains of apatite, zircon and albite. Micrographic intergrowths of plagioclase and quartz appear abundantly. The plagioclase is very saussuritized. Chloritization of the pyroxene is present. The rather altered dolerite macroscopically shows a red feldspar. The texture under the microscope looks ophitic.

Holst in his map description (1892 pp 39 - 42) described this locality, then called Horshäll, as a proterobase (see the locality Bollrup) with high-redded feldspar owing to advanced weathering (p 41).

Skogsmöllan

N55°37' E13°30,5

6167,15 1355,50

2D Tomelilla SV

This dolerite dyke is badly uncovered. Contacts to the neighbouring gneiss are not exposed. The direction of the dyke is N10E. One sample (72032) of the coarsely medium-grained, subophitic dolerite has been whole-rock dated with the K-Ar method. Plagioclase laths (labradorite), augite and ore are the most frequent constituents. Apatite, biotite, quartz and some calcite are present and also micrographic intergrowths and antiperthite. The plagioclase is somewhat sericitized. Chloritization of the pyroxene is present.

Stora Björkeröd

N56°19' E14°13,5

6244,50 1402,15

3E Karlshamn NV

The direction of this 50 m wide dolerite dyke is N30E. The rock, exposed in a magnifique quarry, shows fine-grained, schistosed child contacts, while the central part of the dyke is medium to coarse-grained. The dip is 80E and the texture is subophitic. The surrounding rock is a gneiss granite. Seven samples, taken across the northern part of the uncovered dyke, have been K-Ar dated (71173 - 71179, whole-rock). The two samples from the margins (71173 and 71179) microscopically look to be much more cracked and serpentinized than the others. The plagioclase and the pyroxene have been separated from the sample 71174 and K-Ar dated. The plagioclase has 5 % impurities foremost of pyroxene and ore. The pyroxene, pure to 95 %, has strains of plagioclase and ore. Four Rb-Sr whole-rock datings have been realized (71176 - 71179).

Plagioclase (labradorite), pyroxene and ore are the main components of the rock. Apatite appears abundantly. Serpentine and biotite are common minerals, while quartz, potassium feldspar, hornblende and rutile form single grains. The plagioclase makes to two millimeters long, pigmented laths showing sericitization, saussuritization and antiperthite. The pyroxene is more or less serpentinized. It consists of both hyperstene and augite.

Lundegårdh (1971 p 146) has briefly described the quarry. The map

description (Blomberg 1892 p 17) mentions this occurrence.

Tolånga

N55°38' E13°46'

6168,90 1371,80

2D Tomelilla SV

Tolånga is the type locality of the Skåne melaphyres. The dark red-lilac melaphyre shows amygdaloids in a fine-grained matrix. The melaphyre strikes about N50W. It intersects a Colonus shale.

Munthe et al (1920 pp 34 - 35) pointed out that enclosures of the wall-rocks, foremost the shale, in the margins of the melaphyre is a characteristic feature. The occurrence is mentioned by Törnebohm & Hennig (1904 pp 84 - 85) and is detaillly described by Hadding (1916 pp 28 - 29), who also mentioned the enclosures of foreign material (pp 21, 27).

Calcite forms 1 - 5 mm large amygdaloids. The rock consists of plagioclase laths, augite phenocrysts and single olivine phenocrysts along with colourless glass, calcite, ore, chorite, quartz and apatite. The olivine is serpentized and the plagioclase (labradorite) is somewhat saussuritized. One sample (71165) has been whole-rock dated with the K-Ar method.

Torekov

N56°26,5' E12°33'

6262,10 1304,45

4C Halmstad SV

Along the beach of Torekov a number of subophitic dolerite dykes can be found. Malmberg (1955) has published a map and a description of this section of the beach, representing four dolerite dykes. Number one (73007) and number three (73009) from the south now have been whole-rock K-Ar dated. They are 3 m and 12 m wide, respectively. Both of them intersect a sandstone in the direction N70W. On the geological map of Hummel (1877 p 13) only two dykes can be seen.

Plagioclase laths (labradorite) appears abundantly in this dolerite. Ore, pyroxene (augite), serpentine, quartz, apatite and biotite are noted. Micrographic intergrowths of quartz and

plagioclase are present. The sample 73007 is the best preserved one out of the two dated samples.

Torpa Klint

N55°41' E13°40'5

6174,30 1365,75

2D Tomelilla SV

Hjelmqvist (1939) produced a thorough description of the rocks in the quarry at Torpa Klint. Bylund (1973) has realized palaeomagnetic studies of several of the dykes.

The granite gneiss is crossed over by a number of fine-grained, decimeter- to meter-wide, subsilicic, more or less melaphyric dykes. Their direction varies around NW. The dip is about 65SW. Four of the dykes have been whole-rock dated with the K-Ar method (71153 - 71155 and 71159). The melaphyric rocks show amygdaloids foremost of calcite (often with a core of quartz), but also of chlorite and epidote (Hjelmqvist 1939 p 8). The samples 71154 and 71159 are taken from the most melaphyric dykes, showing amygdaloids surrounded by chlorite, ore, plagioclase (andesine, somewhat saussuritized), hornblende, serpentine, apatite, glass and calcite. Serpentinized phenocrysts of olivine (0.5 - 2 mm) and augite (0.5 - 2 mm) appear. The later sometimes is so completely replaced by calcite that only the crystal shape of the augite is preserved. Calcite forms single crack-fillings.

The samples 71153 and 71155 represent a less melaphyric type, although millimeter-large eyes of calcite are seen. Augite and olivine form phenocrysts surrounded by chlorite, ore, calcite, serpentine, plagioclase (andesine), apatite and biotite. The augite is a bit altered to chlorite and serpentine. The plagioclase is saussuritized (calcite).

Earlier, a dyke of augite porphyrite, the best preserved form of the melaphyre, could be found in this quarry (Hjelmqvist 1939 pp 6 - 7). It now only appears as blocks. One sample of the augite porphyrite (72055) from the mineral collection of the Geological Institute at the University of Lund has been whole-rock K-Ar dated. Under the microscope the rock shows up to one centimeter large phenocrysts of augite and somewhat smaller phenocrysts of olivine in a fine-grained matrix foremost of brown hornblende, ore and

glass. Chlorite, serpentine, calcite and apatite appear along with small quantities of talc, epidote, biotite and plagioclase. The olivine phenocrysts are serpentized and chloritized.

In the southern part of the old quarry a five meters wide dyke of syenite porphyry appears, striking N55W and dipping 65SW. The K-Ar dated sample (71157) is taken from the central part of the dyke, where the rock is medium-grained and a bit lighter in the red colour than in the more fine-grained margins. A biotite concentrate with impurities of potassium feldspar to about 10 %, has been K-Ar dated.

In a matrix of potassium feldspar, biotite, ore, calcite, chlorite and apatite, laths of plagioclase are found. The biotite is foremost green in colour, but a brown core sometimes appears. The biotite shows replacing by chlorite. Sericitization of the plagioclase is seen. The calcite appears not only in the matrix but also as small grains on the plagioclase laths. The syenite porphyry, according to Hjelmqvist 1939, is formed by regeneration of the granite gneiss in connection to the activity of the subsilicic magma, which partly melted the adjacent parts of the granite gneiss. The materia then was pressed upwards, forming a dyke with another composition than the surrounding granite gneiss (Hjelmqvist 1939 pp 14 - 15).

Wallengrens grotta, Kullaberg

N56°18' E12°27'

6246,30 1292,40

3B Höganäs NO

The E - W "kullaite" dyke crosses an amphibolite. The width of the dyke is about three meters. The texture is subophitic. One fine-grained sample (72020) has been whole-rock dated with the K-Ar method. The rock is altered and it consists of plagioclase laths (andesine), potassium feldspar, chlorite and ore as essential minerals, but also augite, calcite, epidote, apatite, quartz and biotite. The biotite is partly altered by chlorite. Sometimes just the crystal shape of the augites is preserved. The amygdaloids consist of feldspar, chlorite, calcite and epidote.

The rocks of Kullaberg was described by Hennig (1898), Hjelmqvist (1930), Behrens (foremost 1953) and Forsell (1962).

Åstorp

N56°8' E12°57'

6225,95 1322,50

3C Helsingborg NV

The granite gneiss in the large quarry of Åstorp is transversed by dolerite dykes. One sample from the finely medium-grained dolerite in the southern wall (72001) and one from the medium-grained dolerite of the eastern wall (72004) have been dated (K-Ar, whole-rock). The dated plagioclase and pyroxene concentrates of the sample 72004 are pure to 98 % and 85 %, respectively. The latter shows impurities of plagioclase and ore. The direction of the dykes is about N65W. The mineral content is dominated by plagioclase laths and augite. Ore, serpentine, quartz, biotite, chlorite, apatite and calcite are the other constituents. Sericitization and micrographic intergrowths of plagioclase and quartz are present. The augite and the biotite are chloritised. The plagioclase is a labradorite - andesine. The texture is subophitic.

Önnestad

N56°3' E14°0'

6214,70 1387,20

3D Kristianstad SO

In the quarry at Önnestad the gneiss granite is intersected by syenite and dolerite. The syenite forms an about 400 m wide massif or dyke. Like the dolerites the syenite has schistose margins. The Rb-Sr dated sample (73062) is taken 22 m apart from the eastern contact. The sample 73061, taken 17 m from the eastern contact, has been K-Ar whole-rock dated.

The 20 m wide dolerite dyke strikes N60W and dips vertically. It intersects both the syenite and the gneiss granite. The K-Ar dated sample (72202) is taken from the fine-grained margin. The plagioclase of this sample (purity 98 %) has been dated separately (72202 plagioclase).

The dolerite under the microscope shows more or less sericitized and saussuritized plagioclase (57 %, labradorite, 1 mm long laths), pyroxene (24 %, augite), opaque minerals (7 %), biotite (2 %), apatite (2 %), potassium feldspar (2 %) and quartz (1 %). Hornblende, serpentine, chlorite and muscovite totally make 5 %. K. A. Kornfält

has informed about the percentages.

The syenite is medium-grained and dark grey. It foremost consists of potassium feldspar, hornblende, biotite and quartz. Ore, plagioclase, apatite, serpentine and some muscovite are noted.

In the map description of Karlsson (1879 p 10) the syenite is rendered as a fairly coarse-crystallinic granite consisting of dark grey feldspar, brown quartz and more or less dark mica and also containing magnetite and garnet.

Östraby

N55°45' E13°42,5

6182,05 1368,20

2D Tomelilla NV

Large blocks of coarsely medium-grained, subophitic dolerite in a probable old quarry was sampled (72034). A Silurian shale forms the wall-rock. Contacts have not been observed. The K-Ar method was used for the whole-rock dating. The mineral assembly is composed of plagioclase laths (1 mm long, labradorite - andesine), augite, ore, chlorite, quartz, calcite, apatite, needles of amphibole and some biotite. The plagioclase laths are somewhat saussuritized and sericitized. Micrographic intergrowths are frequent. Antiperthite is present only in a small quantity. The augite is chloritized.

The locality was mentioned already in the map description of Tullberg (1882 p 32).

THE LABORATORY PROCEDURE

K-Ar

The chemical preparation for flame photometric analyses of K follows the method of Cooper (1963 pp 525 - 546) apart from the use of a caesium sulphate buffer. The preparation begins with weighing of a small quantity of the fine-ground sample (0.10 - 0.25 g, weighed with an exactness of five decimals). The higher quantity is taken when the potassium content is expected to be low, around one per cent.

The sample, taken in a platinum crucible, is heated on water-bath after addition of 5 ml 40 % sulphuric acid and 25 ml 40 % hydrofluoric acid. The hydrofluoric acid is evaporated for about two hours, before a second portion of hydrofluoric acid is added. After another vaporization the removing of silicon as a fluoride is finished. Some few milliliters of nitric acid oxidizes Fe^{2+} to Fe^{3+} . The platinum crucible is heated above a burner until the sulphuric acid emits a heavy, white fume.

Addition of half a gram of caesium sulphate dissolved in 50 ml distilled water then follows. The caesium subdues the ionisation of other elements such as calcium, magnesium, iron and aluminium, which else could disturb the potassium measurements. The water is evaporated and the sulphuric acid is fumed again.

The solution is conveyed into a vycor beaker to a quantity of ca. 50 ml. Five milliliters filter pulp of cellulosa powder and five drops of the indicator bromocresolegreen is added and the solution is neutralized with concentrated ammonia. Salts of for example iron and aluminium are precipitated with help of 5 ml 10 % ammonium carbonate. The effect is risen by heating on water-bath for some minutes.

After complete cooling the solution is filtered (filter paper 9 mm 00) into a weighed plastic bottle to a quantity of around 250 mm. The filter pulp is washed with distilled water. The solution is homogenized and the weigh is noted.

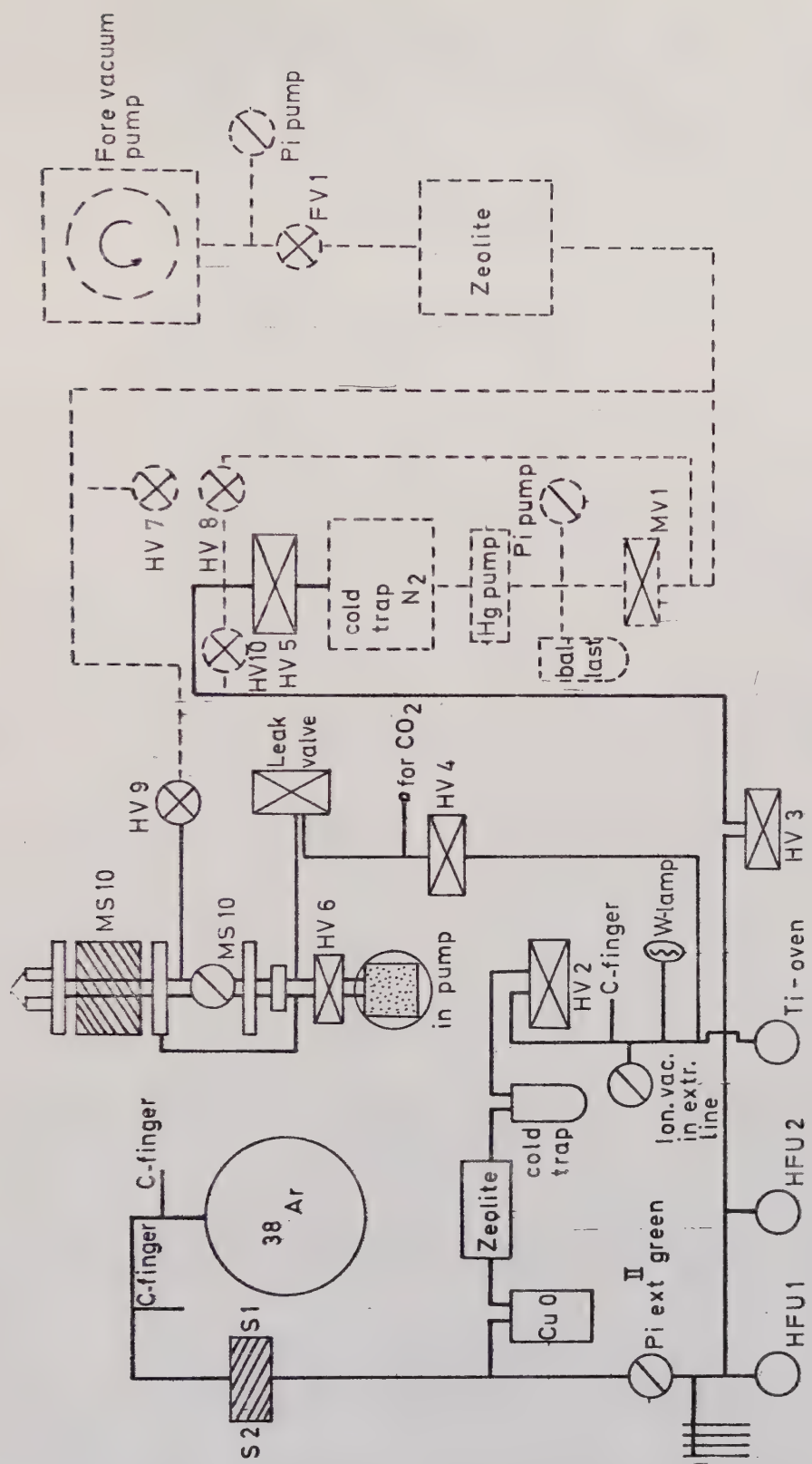
The radiogenic argon is analysed by isotope dilution using an AEI (Associated Electrical Industries) MS10 mass spectrometer connected to an extraction line, a spike reservoir and a pump system Fig. 2).

In the glass system of the extraction line there are two ovens for samples. The system is cleaned by overnight baking at about 300°C which improves the vacuum. The vacuum in the extraction line then is $1 \cdot 10^{-6}$ to $1 \cdot 10^{-7}$ mm Hg and the back-ground in the whole system (mass spectrometer + extraction line) is ignorable. Before heating up one of the samples the copper oxide oven is heated to 525°C . By a high frequency generator the sample is melted at about 1400°C for at least a quarter of an hour and the gases are emitted.

When the gases from the heated sample pass the copper oxide oven, hydrogen is oxidized to water and carbon monoxide to carbon dioxide. A spike dose is taken out from the spike reservoir via the spike gas pipette, and is mixed to the gases from the sample. Impurities from the sample, such as hydrocarbons, are taken up by a coal finger cooled by fluent oxygen or nitrogen. Oxygen ought to be the better one as its boiling point lies at -183°C , which is somewhat lower than for argon (-186°C). The argon gases because of that are not fixed in the coal finger. The boiling point of nitrogen (-196°C) lies above that of argon and, consequently, freezing with nitrogen can cause taking up also of argon gas. However, disturbances of the results at using nitrogen have not been observed. The extraction line is further purified by a titanium sponge which at heating to 800°C takes up impurities. Dampness, foremost in connection with changing of the samples, is taken up by a zeolite trap.

The spike reservoir contains an artificial argon gas, which to 99.9 % consists of the isotope argon-38. The composition of the spike must be calibrated continuously by dating a standard.

Through a gas pipette the spike dose is let into the extraction line to be mixed with the argon gases from the sample. The mixture is let into the mass spectrometer in the static way, that is, the whole quantity comes into the mass spectrometer at a time and is not pumped away until the measurements are finished. The vacuum in the mass spectrometer is $1 \cdot 10^{-8}$ mm Hg.



— High vacuum
 --- Fore vacuum

Fig. 2

The concentrated standard solution is produced in the same way, starting with potassium sulphate. This solution then is diluted with a 0-solution to the wanted concentrations.

A Zeiss Spectrophotometer PMQII is used for the flame photometric analyses of potassium, using emission. The wave-length for potassium is 766.8 mm and the fissure is 0.8 mm. The gase is a mixture of air and propane.

The intensities of the standard solutions are plotted against the concentration (Fig. 1). Then, the potassium contents of the samples can be read from the measured intensities. To check the position of the curve, a standard sample accompanies all series of measurements. The muscovite standard of the Swedish Museum of Natural History in Stockholm, 68121, is used.

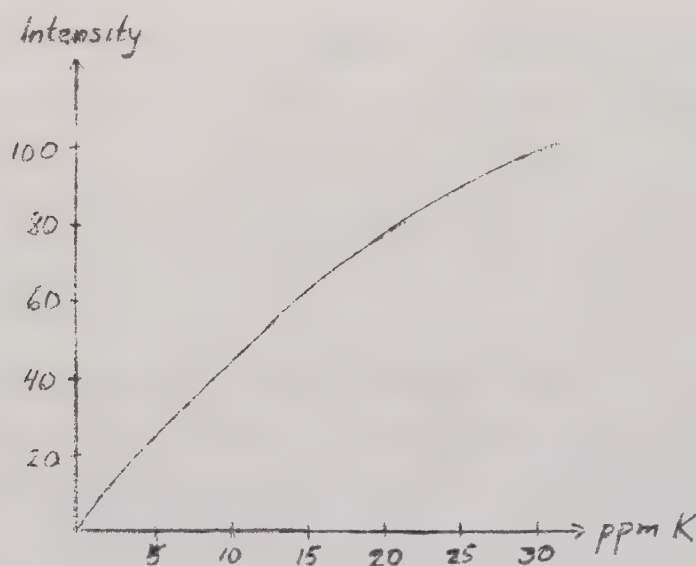


Fig. 1: A standard curve for determination of potassium

At least two analyses a sample are done. The standard deviation is ± 1.3 %. The evaporation must be corrected for.

The potassium contents (expressed in parts per million, ppm), read from the standard curve, are multiplied by the weigh of the filtered solution and are divided by the value of the initial weigh of the sample. The result finally is expressed in per cent K instead of ppm K.

Due to smaller differences in the physical properties of the isotopes and the mass spectrometer a discrimination correction must be done continuously. A small quantity of argon from the atmosphere is analysed and the result is compared to the real $^{40}\text{Ar}/^{36}\text{Ar}$ ratio in air (295.5). The calculation of the K-Ar model age follows the procedure of Dalrymple & Lanphere (1969 pp 247 - 248).

Rb-Sr

The chemical preparation for Rb-Sr dating starts with weighing a small quantity (0.5 - 2.0 g) of the sample. For an unspiked dating just an appropriate idea about the weight is needed. A larger quantity is taken for samples with low rubidium contents than for rubidium rich samples.

If the sample is to be spiked, solutions produced from rubidium chloride, RbCl , and strontium nitrate, $\text{Sr}(\text{NO}_3)_2$, are added. The quantities of the sample and the two spike solutions must be carefully known. When the spike is added and the mixture is homogenized a quantitative analysis is no longer necessary. Just contamination is to be avoided.

Hydrofluoric acid (10 ml) and perchloric acid (2 ml) are added to the mixture, taken in a platinum crucible. The portion is evaporated at about 130°C . First, water, hydrochloric acid and hydrofluoric acid are boiled away. When the perchloric acid then starts to boil away, a white fume appears. A second portion, and perhaps a third, of hydrofluoric acid and perchloric acid is added and evaporated. After addition of the last portion the mixture is evaporated to dryness and the temperature is risen to 500°C for some minutes.

The burnt remainder is dissolved in 2.5-n hydrochloric acid. Some drops of perchloric acid are added to assure the existence of ClO_4^- -ions in the solution for precipitation of potassium and rubidium as perchlorates.

By means of 2.5-n hydrochloric acid, the portion is transferred into a 50 ml centrifuge tube to a quantity of 25 ml. After cooling for at

least one hour the solution is centrifugated. The bright solution is then anew evaporated in the cleaned platinum crucible. After dissolving in 2.5-n hydrochloric acid the solution is conveyed into a 15 ml centrifuge tube to a volume of 15 ml. The solution is cooled for at least one hour before centrifugation and ion exchange.

The two precipitates, given at the centrifugations, consist of potassium- and rubidium- perchlorates. They are repeatedly washed with alcohol, are centrifugated and decanted until the yellow colour of the precipitate is completely gone away.

Then the precipitate is conveyed into a gold crucible by 3-times distilled water. The precipitate is dried. The perchlorates are transferred to chlorides at heating with a bunsen burner. The chlorides are dissolved in 0.2-n nitric acid and are conveyed into a 5 ml centrifuge tube to a volume of 5 ml. Before the rubidium ion exchange the solution is cooled for at least one hour and is then centrifugated.

The strontium ion exchange is done with 2.5-n hydrochloric acid in a 50 cm high quartz column with an inner diameter of 18 mm, filled with Dowex 50 Wx 8, 100 - 200 mesh resin. When the sample has run down through the resin catching of the eluate starts. After the first 180 ml, containing iron (Fe^{3+}) and rubidium, the strontium fraction is a part of the following 60 ml. The strontium fraction is taken up in a teflon beaker. To know the time of eluation of the strontium fraction the ion exchange column initially was calibrated by flame photometric analyses of the continuous composition of the eluate.

The rubidium ion exchange is carried out by a 10 cm high column of pyrex glass with an inner diameter of 5 mm. The column is filled with 1.3 g ZP-1 resin, 100 - 200 mesh. When the sample has run through the resin, 40 ml 0.2-n nitric acid is added to eluate the fraction that contain potassium. Then the rubidium fraction is eluated with 10 ml 6-n nitric acid and is caught in a teflon beaker.

The two eluates from the ion exchanges are evaporated next to dryness and are conveyed into 5 ml pyrex beakers. Then they are

ready for mass spectrometric analyses. The gain of rubidium and strontium after this chemical preparation is 70 respective 45 %.

The strontium sample is dripped on a rhenium filament that is heated with a slight current (1.8 A). The sample portion is fixed on the filament by addition of phosphorous acid and then burning.

The filament with the sample portion is put into the ion source of the mass spectrometer (Atlas CH4, Fig. 3) and is degassed with a current of 2.0 A and then successively higher to reduce impurities of rubidium. If the sample is rich in rubidium, a long time degassing (2 - 4 hours at 1.8 A) in a separate apparatus is used. The degassing of rubidium is more effective the higher the current is. However, it is important not to reach the current when the strontium emission starts.

The pumping system consists of a fore vacuum pump, an ion pump, a Booster pump and two mercury pumps. The vacuum in the mass spectrometer is ca. $1 \cdot 10^{-7}$ mm Hg.

All mass spectrometric measurements are analyses of the ratio between ion beams of different mass numbers. No quantitative measurements can be done. All calculations are referred to the base isotope ^{86}Sr . At analyses of unspiked strontium the three isotopes ^{86}Sr , ^{87}Sr and ^{88}Sr are measured. Spiked strontium analyses need the four isotopes ^{84}Sr , ^{86}Sr , ^{87}Sr and ^{88}Sr and a spiked rubidium analysis the isotopes ^{85}Rb and ^{87}Rb .

All values of the spiked strontium analyses are normalized until the $^{86}\text{Sr}/^{88}\text{Sr}$ ratio reaches the value 0.1194 (van Schmus 1966 pp 179 - 181). This correction reduces the effect of the mass discrimination. The rubidium contents are calculated from the $^{85}\text{Rb}/^{87}\text{Rb}$ ratio (= 2.59) and the added spike quantity (Faure and Powell 1972).

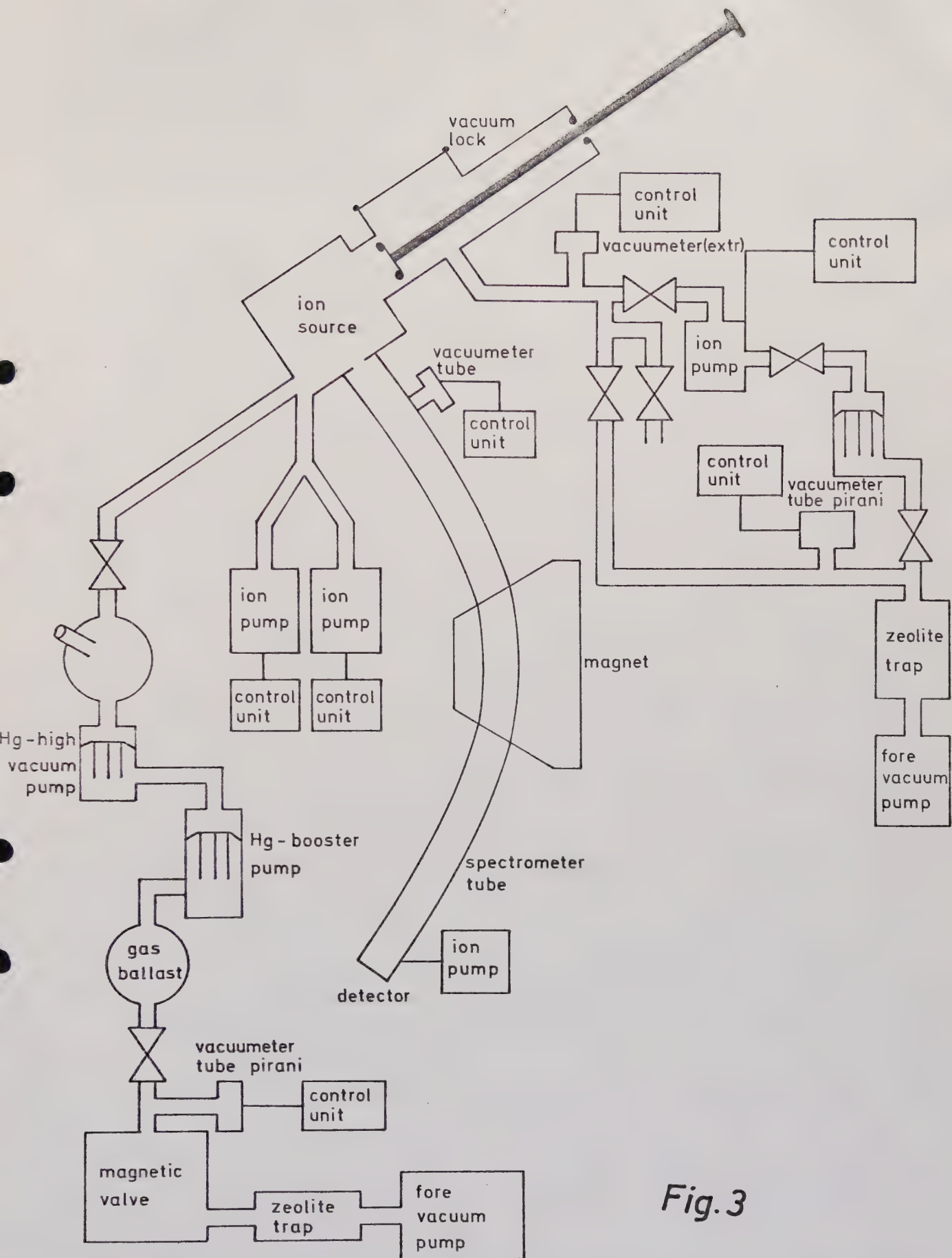


Fig.3

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